UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Alaska Fisheries Science Center
Resource Assessment and Conservation Engineering Division
7600 Sand Point Way Northeast
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Seattle, Washington 98115-0070

December 16, 1994

CRUISE RESULTS

Cruise 94-1 Arcturus
Cruise 94-1 Aldebaran
1994 Eastern Bering Sea Crab and Groundfish Survey
May-August 1994

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) conducted the annual crab and groundfish bottom trawl survey of the eastern

Bering Sea shelf from May to August 1994. This was a continuation of the annual series of eastern Bering Sea crab-groundfish assessment surveys which began in 1971.

OBJECTIVES

The primary objective of this survey was to continue the annual series of assessment surveys of crab and groundfish of the eastern Bering Sea to provide information for:

1. the North Pacific Fishery Management Council on the distribution, abundance, and biological condition of important groundfish and crab species;

2. the U.S. fishing industry on catch-per-unit effort (CPUE) and size composition; and

3. the support of ongoing studies on the biology, behavior, and dynamics of key ecosystem components.

Secondary objectives were to:

1. conduct additional sampling in areas of high king crab and Tanner crab abundance to reduce variability in population estimates;

2. collect maturity data from yellowfin sole for spawning studies;

3. retrieve and redeploy long term bottom temperature sensors which record year-around sea water temperatures;

4. evaluate bottom trawl performance and configuration with net mensuration equipment;

5. collect stomach samples for trophic interaction studies;

6. collect and preserve various whole specimens and tissue samples from both fish and invertebrates for special study requests;

7. record observations of pathological anomalies of various fish species to assess prevalence of infestations;

8. evaluate methods of subsampling large bottom trawl catches using a trouser trawl split codend, and

9. evaluate data on the effect of varied trawl bridle configurations to assess herding behavior of fish into the sampling net.

VESSELS AND GEAR

Sampling at the standard sites was coordinated between two chartered commercial vessels, the F/V Arcturus and F/V Aldebaran. Both vessels were 39.6 m (130 ft) in length.

The standard bottom trawl used at all sampling stations was an 83-112 eastern trawl. These nets have a 25.3-m (83-ft) headrope and a 34.1-m (112-ft) footrope (Fig. 1). They were towed behind 1,000-kg, 1.8-m X 2.7-m, steel V-doors and 54.9-m (180.1-ft) paired dandylines. Each lower dandyline had a 0.61-m chain extension connected to the lower wing edge to improve bottom tending characteristics. The 83-112 eastern trawl has been the standard sampling net used during annual eastern Bering Sea surveys since 1982 when it replaced the 400 mesh eastern trawl, previously used since the 1970s.

Seawater temperature profiles were collected at most sampling sites using a micro-bathythermograph attached to the head-rope of the net. Surface seawater temperatures were also collected with a bucket thermometer lowered over the side of the vessels.

Net mensuration systems aboard both vessels were used to provide sampling net configuration and performance data to be used in area-swept and CPUE calculations.

ITINERARY

The Arcturus and Aldebaran began the survey in Dutch Harbor, Alaska on May 31. The Aldebaran returned to Dutch Harbor on August 2 and the Arcturus returned to Dutch Harbor on August 4

upon the completion of the 1994 eastern Bering Sea crab-groundfish survey. Intervening port calls were made by both vessels in Akutan on June 10, Dutch Harbor, on June 21 and July 12 to obtain supplies and/or exchange scientific personnel.

SURVEY DESIGN AND METHODS

The standard survey area is shown in Figure 2. Sampling sites were established on the basis of a 20-nm x 20-nm grid pattern used during previous surveys, although more intensive sampling was carried out in the Pribilof Islands and St. Matthew Island regions to collect additional data on crab populations. Additional stations northwest of the standard survey area were established to estimate the abundance of Tanner crab (Chionoecetes opilio) in that area. Additional time was allocated to intensify sampling efforts near the standard station locations where large concentrations of king or Tanner crab were encountered.

At the beginning of the survey, the Arcturus attempted to retrieve three temperature array devices near Port Moller which had been deployed during the 1993 eastern Bering Sea crab and groundfish survey. Only one array was located and retrieved. Three new arrays were set off Port Moller and will be retrieved one year later during the 1995 eastern Bering Sea crab and groundfish survey. Information obtained from these units provide a year-around record of seawater temperature fluctuations in Bristol Bay. The Arcturus and Aldebaran then sampled alternate north/south columns of stations proceeding from Bristol Bay westward to the shelf edge. A tow, 30 minutes in duration, was made at most sampling sites. All catches were sorted to the lowest possible taxon, weighed, and enumerated. Station data including time, position, trawl performance, distance fished as well as catch information, were entered onto diskettes with shipboard computer systems. Collections of age samples (by sex-centimeter category), size composition, and other biological data were collected from the major fish species encountered. Length-width measurements, shell condition, clutch size, and tissues and organs for various studies were collected from the major crab species. Special study collections were stored in appropriate fixatives or were frozen.

Upon the completion of the standard survey, a site east of St. Paul Island was selected to conduct the trouser trawl and herding experiments. This location was selected based on the diverse species assemblage and relative abundance.

The trouser trawl experiment was conducted aboard the Aldebaran. This study was initiated to investigate the potential of using a split codend to divide the catch in the sampling net and provide representative portions of the catch in each codend.

During past surveys it has been frequently necessary to subsample large catches (greater than about one ton) by weighing the total catch with a load cell. The catch was then released into a bin partially lined with a cargo net. An attempt was made to orient the codend over the cargo net to avoid potential bias introduced by any vertical stratification that may have been present in the codend. The sampled portion of the catch was then removed by the cargo net and released onto the sampling table for processing. Total catch weights and numbers for individual species and species categories were later extrapolated from the subsampled portion of the catch. However, some observations indicate this method may not provide an adequate sample of the total catch since some species may not be uniformly distributed in the codend. In addition it has not always been possible to orient the codend over the cargo net to assure that the subsample is representative of the total catch.

The single codend of the standard 83-112 sampling net was replaced with a split (or double) codend for this experiment. All bottom trawls were 30 minutes in duration. The catch from both codends was completely sorted and size composition was recorded from various crab and fish species of interest.

The trawl herding experiment was conducted aboard the Arcturus. The primary objective of this experiment was to evaluate the effects of different bridle configurations on the herding behavior of various fish species into the sampling net. At each trawl site, three non-overlapping tows lasting 30 minutes each were conducted by alternating three bridle configurations of 15, 30, and 45 fathoms. All catches were completely sorted and selected fish and crab species were retained for size composition.

RESULTS

The Arcturus and Aldebaran successfully conducted a total of 396 bottom trawls during the survey including 381 successfully completed trawls at scheduled sampling sites, two opportunistic hauls to collect additional information on crab, and 13 unsuccessful hauls. An additional 20 bottom trawls were completed during the trouser trawl experiment and 53 trawls were conducted during the herding study.

Biological data collected from fish species are summarized in Table 1. The two vessels recorded approximately 155,300 length measurements from the major fish species and nearly 4,000 age structures were collected and preserved. Individual length-weight data were also recorded for yellowfin sole. Over 9,600 stomachs were preserved from various fish taxa for feeding habit analysis. Whole specimens and tissue samples of various fish and invertebrate species were preserved for identification, training, and other purposes.

The total standard survey area encompassed approximately 463,400 km^2 and overall catches averaged 330.3 kg/ha trawled. Catch rates of important fish and crab species, by depth zone, are shown in Table 2.

Walleye pollock (Theragra chalcogramma) was the most abundant fish species and had an overall CPUE of 94.6 kg/ha trawled. They were encountered at nearly all sampling sites, with largest mean catches (129.1 kg/ha) observed in outer shelf waters at depths of 100-200 m (Fig. 3). Mean catches were much lower at depths less than 50 m (27.8 kg/ha).

Rock sole (Pleuronectes bilineata) and yellowfin sole (P. aspera) were the most abundant flatfish species, with overall CPUE values of 50.1 kg/ha and 38.3 kg/ha, respectively. Yellowfin sole were primarily restricted to the central and inner shelf waters, while rock sole were more broadly distributed with concentrations in Bristol Bay, around the Pribilof Islands, and the outer shelf (Figs. 4 and 5). Yellowfin sole catches decreased sharply with increased depth, from 91.8 kg/ha in waters less than 50 m to 0.1 kg/ha in waters greater than 100 m. A similar depth-related decrease in rock sole abundance was also observed.

Pacific cod (Gadus macrocephalus) were encountered at nearly all sites sampled (Fig. 6). Catch rates were smallest at inner shelf stations less than 50 m.

Alaska plaice (P. quadrituberculatus), flathead sole/Bering flounder (Hippoglossoides elassodon and H. robustus), arrowtooth-Kamchatka flounder (Atherestes stomias and A. evermanni), and Pacific halibut (Hippoglossus stenolepis) had a combined catch rate of 36.8 kg/ha. Alaska plaice and flathead sole/Bering flounder were the most abundant species of this group, with an overall catch rate of 11.2 kg/ha and 11.9 kg/ha respectively.

Tanner crab (Chionocetes opilio) was the most abundant commercially important crab species encountered, with a total average catch rate of 12.7 kg/ha. Red king crab (Paralithoides camtschatica), blue king crab (P. platypus), and Tanner crab (C. bairdi) each had overall catch rates of about 1.0 kg/ha trawled.

SCIENTIFIC PERSONNEL[a]

Leg 1	Leg 2	Leg 3
Arcturus		
C. Armistead[b]	B. Otto[bc]	P. Goddard[b]
P. Goddard	C. Armistead	D. Nichol
D. Smith	L. Faughnan	B. Page
J. Hagga[c]	L. Mooney	R. MacIntosh[c]
B. Dew[c]	B. Page	N. Terrell[c]
	S. Payne[c]	P. Monroe
Aldebaran		
T. Sample[b]	G. Walters[b]	T. Sample[b]
D. Roetcisoender	B. Lauth	B. McConnaughey
F. Morado	T. Buckley	C. Derrah
R. Wiggins	P. Cummiskey[c]	E. Munk[c]
B. Stevens[c]	K. Smith[c]	K. Smith[c]
F. Hartsock[c]		L. Kodolov[d]

[a] Personnel from the AFSC, Seattle, unless otherwise noted
[b] Field Party Chief
[c] Personnel from the AFSC, Kodiak Laboratory
[d] Personnel from the Pacific Research Institute of Fisheries and Oceanography (TINRO), Vladivostock, Russia

For further information contact Dr. Gary Stauffer, Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE., Building 4, BIN C15700, Seattle, WA 98115-0070. Telephone (206) 526-4170.

Table 1.--Biological data collected by the Arcturus and Aldebaran during the 1994 eastern Bering Sea crab-groundfish survey.

Species	Length measurements	Age structures[1/]	Stomach samples
Walleye pollock	38,901	1,156	3,247
Pacific cod	13,891	746	2,528
Yellowfin sole[2/]	26,916	526	815
Rock sole	29,047	464	391
Flathead sole/ Bering flounder	22,651	374[3/]	557
Pacific halibut	1,560	--	290
Alaska plaice	9,653	188	262
Arrowtooth flounder/ Kamchatka flounder	9,585	306[4/]	505
Greenland turbot	536	197	94
Rex sole	304	--	--
Sakhalin sole	122	--	--
Starry flounder	29	--	--
Arctic cod	672	--	--
Pacific herring	397	--	--
Eelpout species	378	--	378
Skate species	462	--	462
Misc. species	166	--	143
Total	155,270	3,957	9,672

[1/] Scale scrape samples, in addition to otoliths, were collected from Pacific cod. Only otoliths were taken from all other species.
[2/] Individual length-weight data were also collected from yellowfin sole.
[3/] Age structures were collected from flathead sole only.
[4/] Age structures were collected from each species separately.

Table 2.--Catch rates (kg/ha) by depth zone of commercially important fish and crab species taken aboard the Arcturus and Aldebaran during the 1994 eastern Bering Sea crab-groundfish survey.

Species	Inner shelf < 50 m	Central shelf 50-100 m	Outer shelf 100-200 m	Total area
Walleye pollock	27.8	113.9	129.1	94.6
Yellowfin sole	91.8	29.1	0.1	38.3
Rock sole	88.4	54.6	4.4	50.1
Pacific cod	19.7	29.3	30.7	27.1
Alaska plaice	13.2	15.8	1.6	11.2
Flathead sole/ Bering flounder	4.1	13.8	16.5	11.9
Arrowtooth flounder/ Kamchatka flounder	0.2	8.6	23.9	10.5
Pacific halibut	2.7	2.9	4.0	3.2
Opilio Tanner crab	20.0	12.1	5.3	12.7
Red king crab	0.5	1.4	0.0	0.8
Bairdi Tanner crab	0.2	1.5	1.0	1.0
Blue king crab	<0.1	1.6	0.5	0.9
Total effort (hectares)	407.2	743.3	417.9	1,568.4

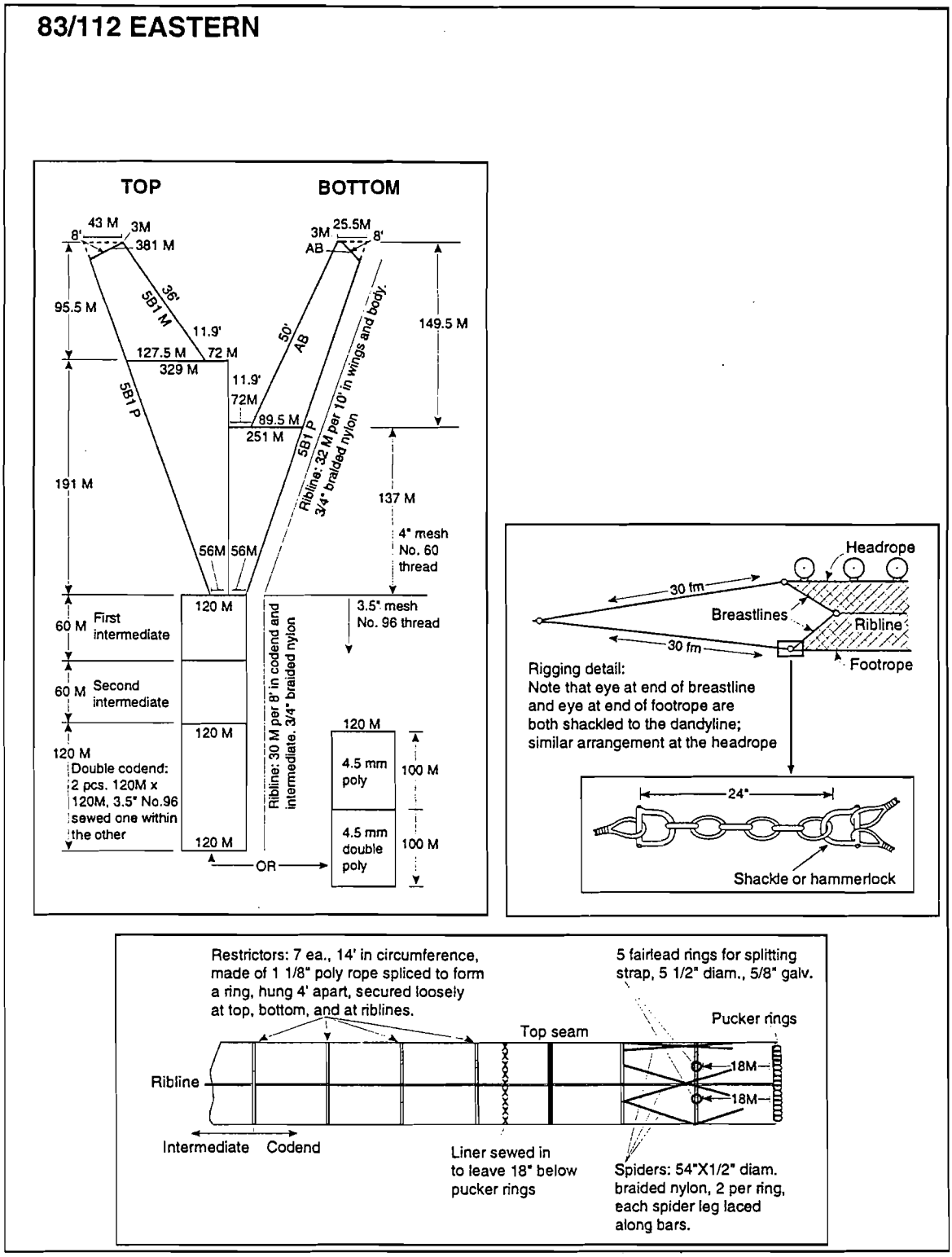

Figure 1.--Diagram of the 83-112 eastern bottom trawl used during the 1994 eastern Bering Sea crab-groundfish survey.

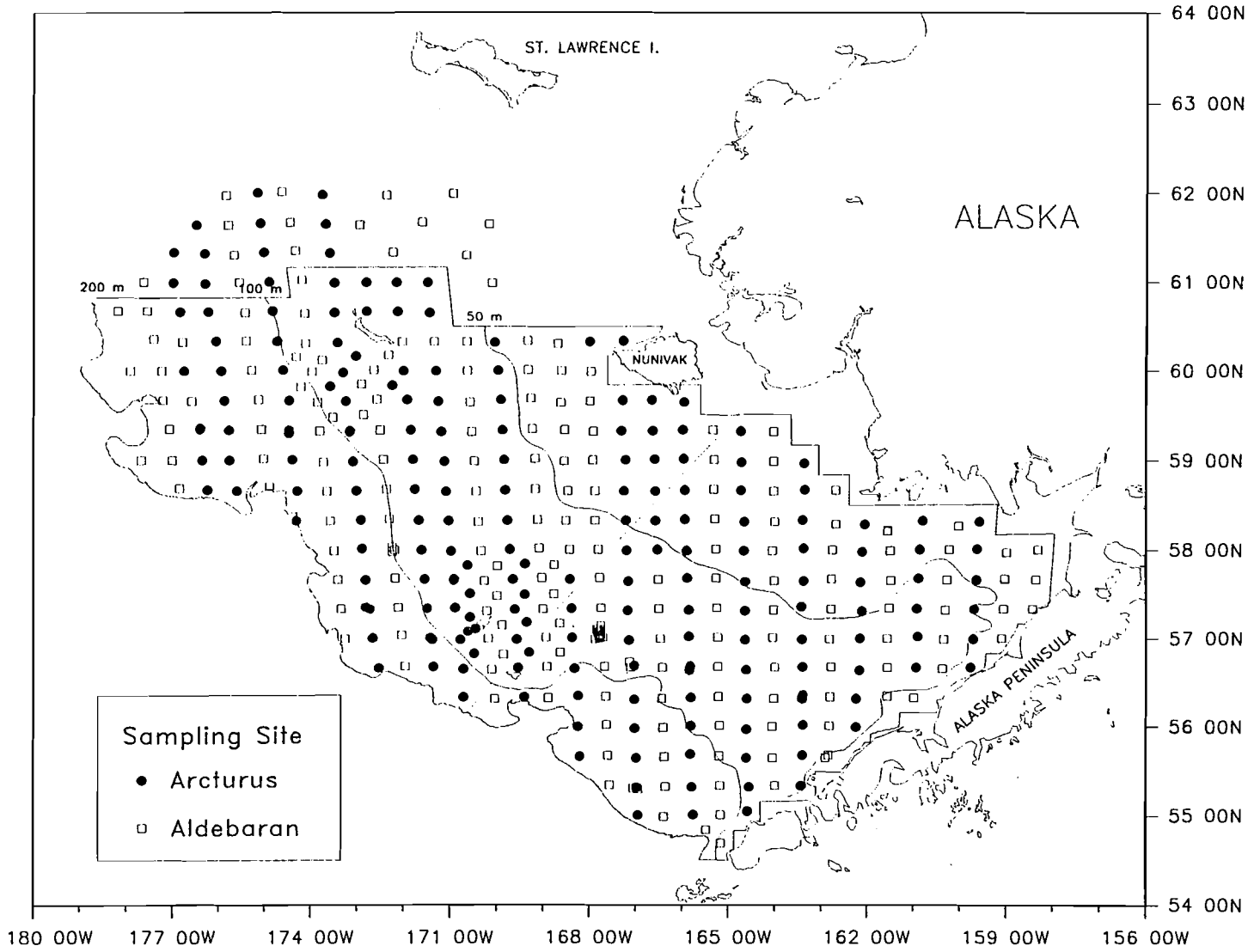

Figure 2.--Distribution of sampling effort by the Arcturus and Aldebaran during the 1994 eastern Bering Sea crab-groundfish bottom trawl survey.

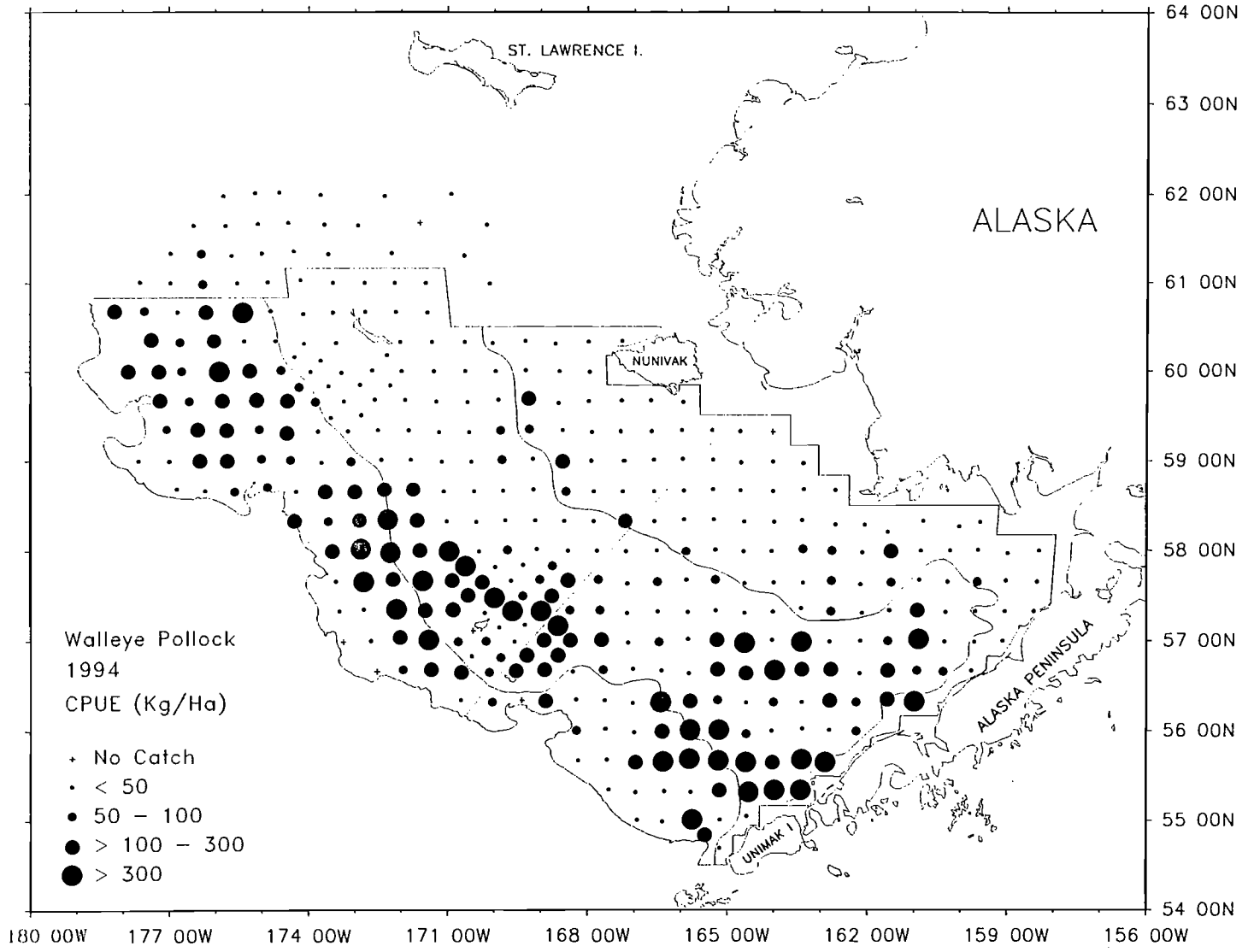

Figure 3.--Distribution and relative abundance in kg/ha of walleye pollock during the 1994 eastern Bering Sea bottom trawl survey.

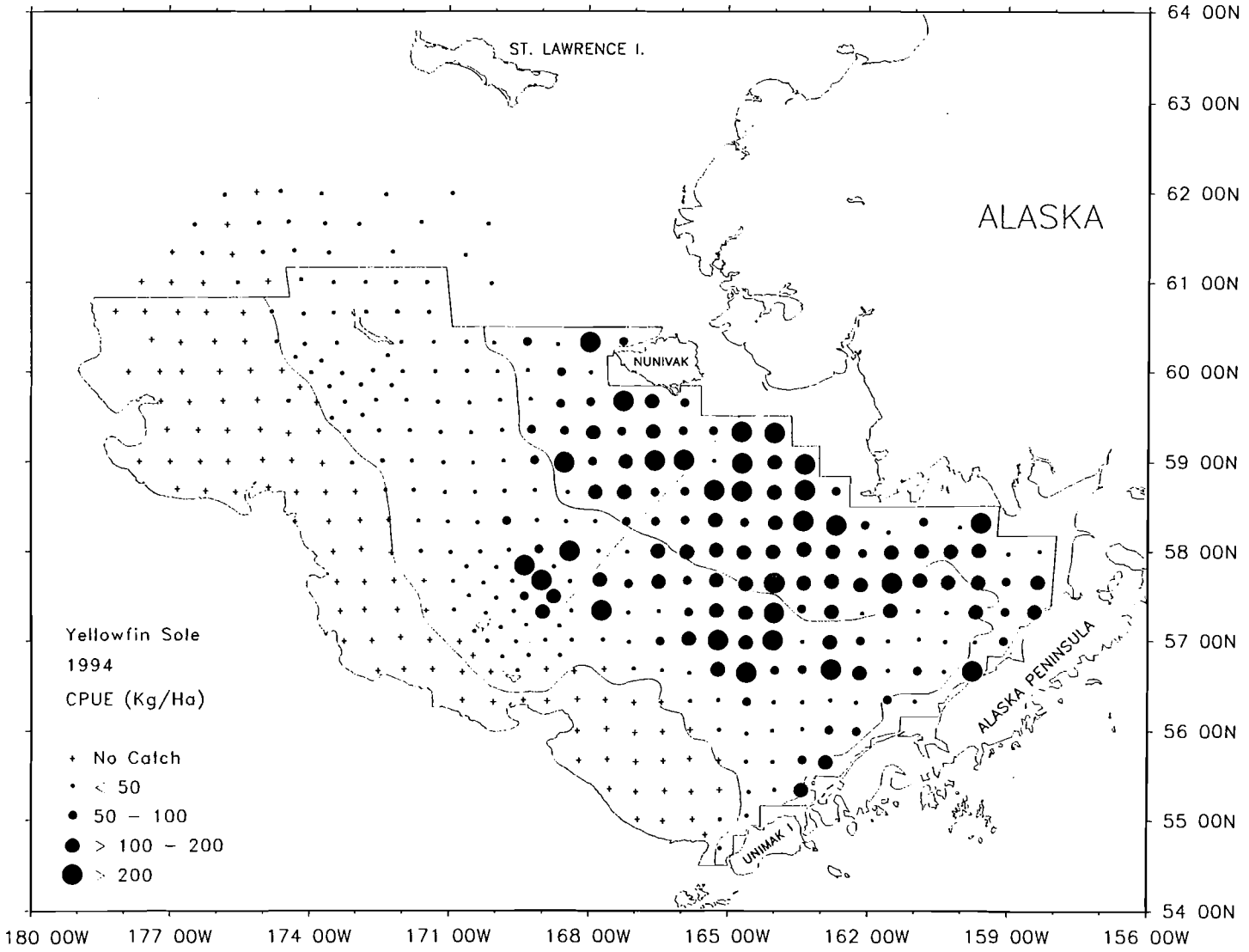

Figure 4.--Distribution and relative abundance in kg/ha of yellowfin sole during the 1994 eastern Bering Sea bottom trawl survey.

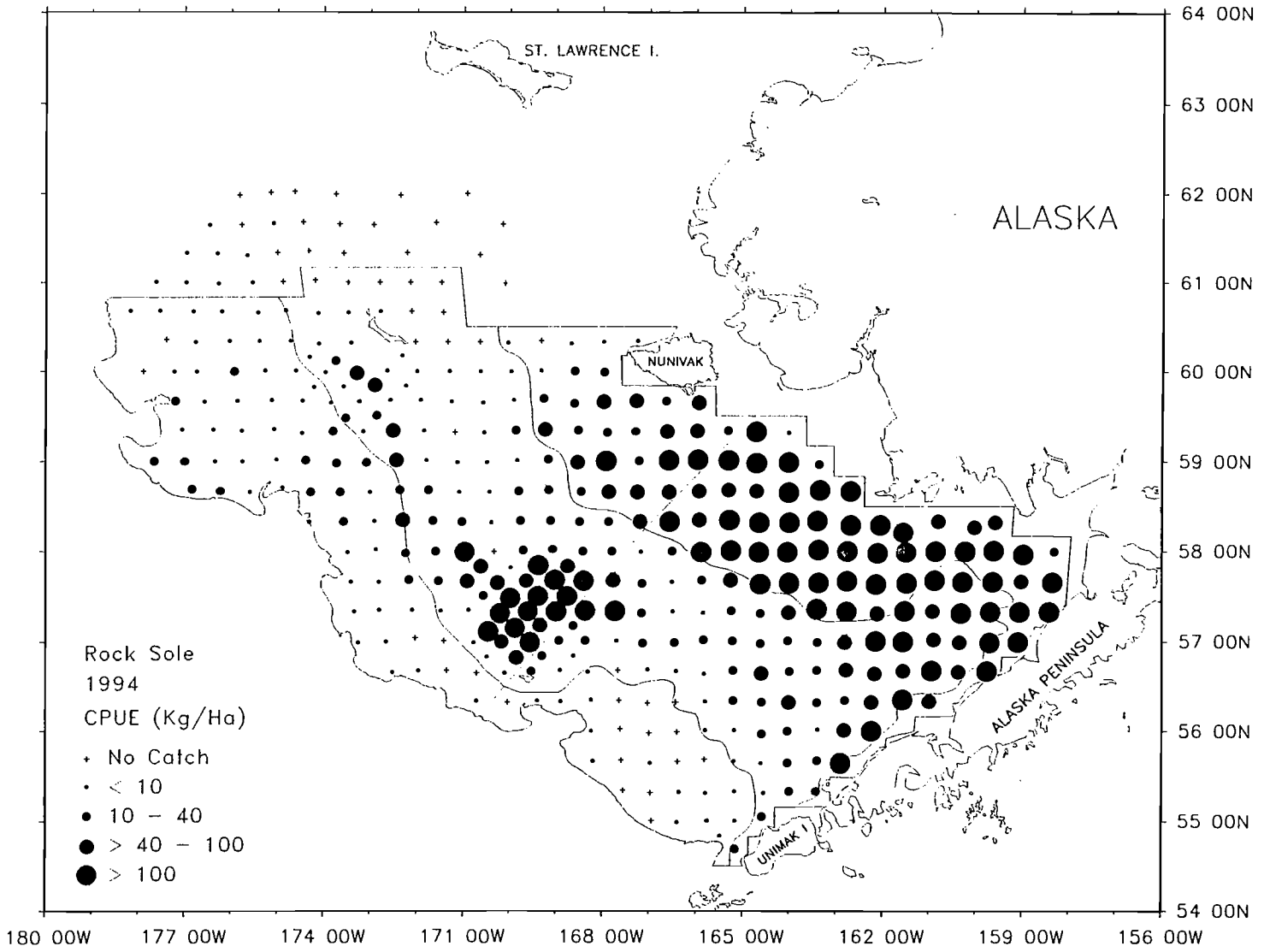

Figure 5.--Distribution and relative abundance in kg/ha of rock sole during the 1994 eastern Bering Sea bottom trawl survey.

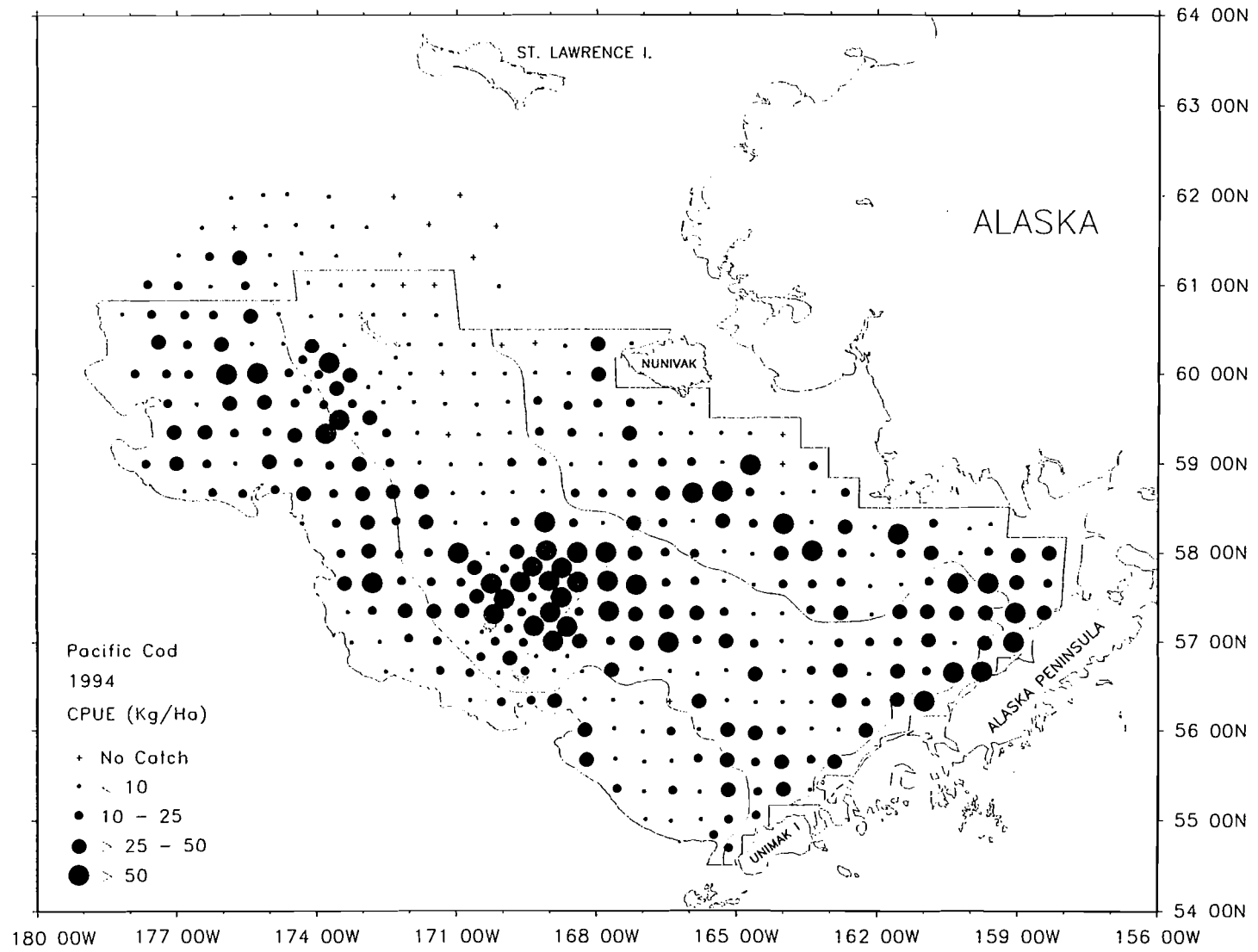

Figure 6.--Distribution and relative abundance in kg/ha of Pacific cod during the 1994 eastern Bering Sea bottom trawl survey.